

Flagstaff Water Works Part II: Our Water Future

Water Resources Chapter of the Utilities Integrated Master Plan

Sponsored by:
Friends of the Rio de Flag & Friends of Flagstaff's Future

Presented by:
Erin Young, R.G., Water Resources Manager
City of Flagstaff Utilities Division

October 3, 2013



Presentation Outline

Utilities Integrated Master Plan

Water Management

Historic Augmentation Projects

Regulatory Framework

Water Use & Existing Supply

Historical & Current Use

Physical Availability of Supplies

Demand Projections

2009 Demand Study

Water Demand Scenarios

Water Supply Options

Conservation

Reclaimed Water Reuse

Wells

Imported Supplies

Summary

UTILITIES INTEGRATED MASTER PLAN

Water Resources Chapter

Water History, Demand, Existing Supplies and Future Water Needs and Recommended Options



April 8, 2011

City of Flagstaff - Utilities Division



EXPIRES 03/31/12

Elements of WRMP

Utilities Integrated Master Plan Purpose:

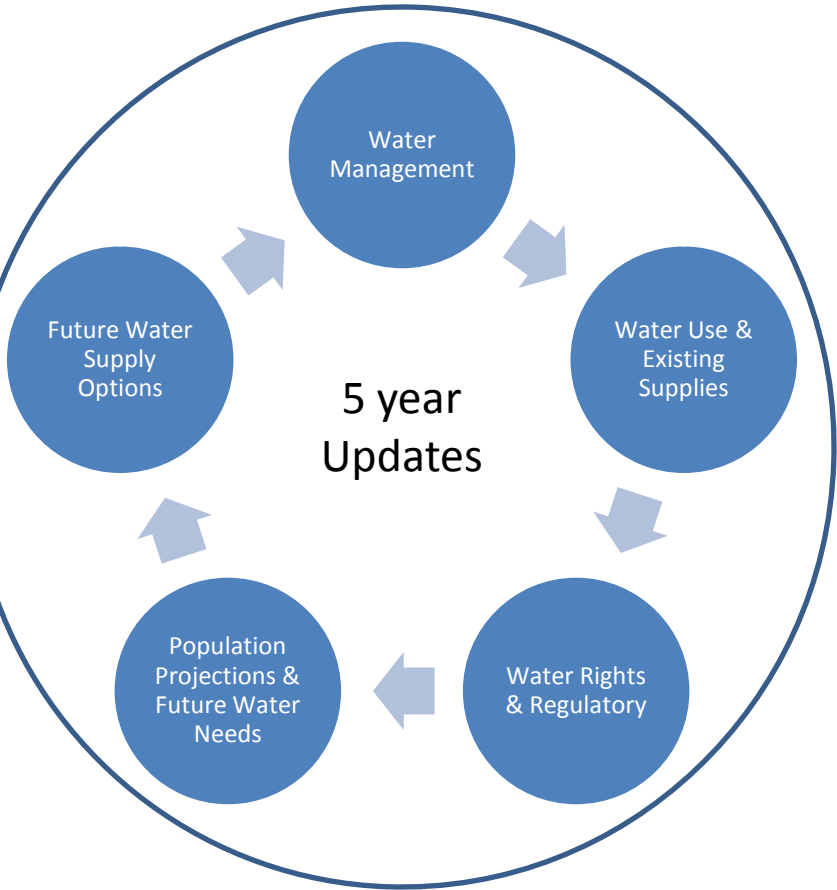
Provides guidance for water resource & infrastructure planning

City-wide integration:

Voter-approved Regional Plan, Sustainability’s Resiliency & Preparedness Plan, Stormwater Section, etc.

Five Chapters:

- 1. Water Policies (on Council’s agenda)
- 2. Water Resources
- 3. Water Infrastructure
- 4. Wastewater Infrastructure
- 5. Reclaimed Water Infrastructure



Historic Augmentation Projects

- City has constructed three major water importation projects since the 1890s for a total of ~33 miles of pipeline!



- Up until 2001 City's supplies were 100% from outside city limits!

Historic Augmentation Projects

- City has investigated numerous water augmentation projects over the last 100 years, including:
 - 1919 – “Most Remarkable Domestic Water & Power Project” – Rainwater Harvesting on Peaks (12,275 AF/yr)
 - 1921 – Switzer Canyon & Fort Valley Dams – Los Angeles engineers and geologists/John Carollo Engineers (1932)
 - 1969 – Central Arizona Project – City submitted an expression of interest letter (15,040 AF/yr @ \$32.50/AF or \$132/AF in 2010 dollars)
 - 1972 – Harshbarger & Carollo – (project list on following slide)
 - 2006 – North Central Arizona Water Supply Study – (project list on following slide)



Inner Basin Water Supply Line, ca. 1890s

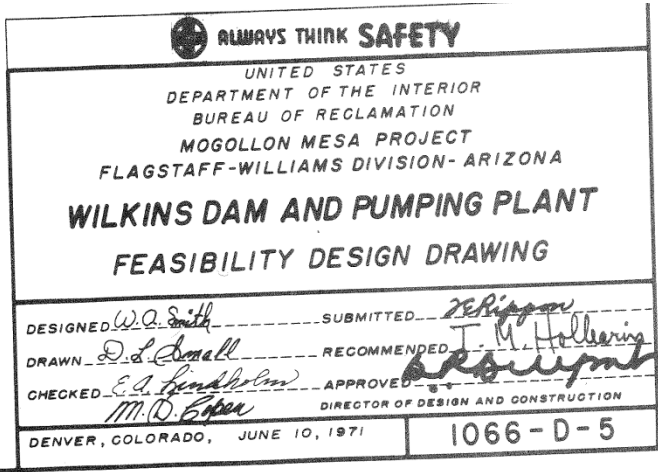
1 AF/year = 4 homes in Flagstaff

Historic Augmentation Projects

- 1972 – Harshbarger & Carollo
 - Upper East Clear Creek well field (~8,000 AF/yr @ \$4,250/AF)
 - Canyon Diablo well field (~8,000 AF/yr @ \$3,644/AF)
 - Redwall Aquifer well field (~8,000 AF/yr @ \$1,480/AF)
 - Effluent Reuse
 - Lake Mary Lining (~1,600 AF/yr @ \$5,905/AF)
 - Mogollon Mesa Project (18,400 AF/yr @ \$12,648/AF)
 - Weather Modification (211 AF/yr @ \$1,387/AF)



Wilkins Dam site



- 2006 – BOR North Central Arizona Water Supply Study
 - **Lake Powell – Colorado River**
 - Lake Mead – Colorado River
 - Little Colorado River Tributaries – Mogollon Mesa
 - Little Colorado River groundwater – high TDS (saline)
 - Redwall-Muav Aquifer
 - **Red Gap Ranch – Coconino Aquifer**

Projects in **bold** text are in feasibility stage

Regulatory Framework

Arizona Department of Environmental Quality

- Safe Drinking Water Act & Clean Water Act
- AzPDES & Aquifer Protection Permits

Arizona Department of Water Resources

- **Designation of Adequate Water Supply 2013**
- Underground Storage & Recovery Rules
- Water Rights and Adjudication



➤ Water Rights

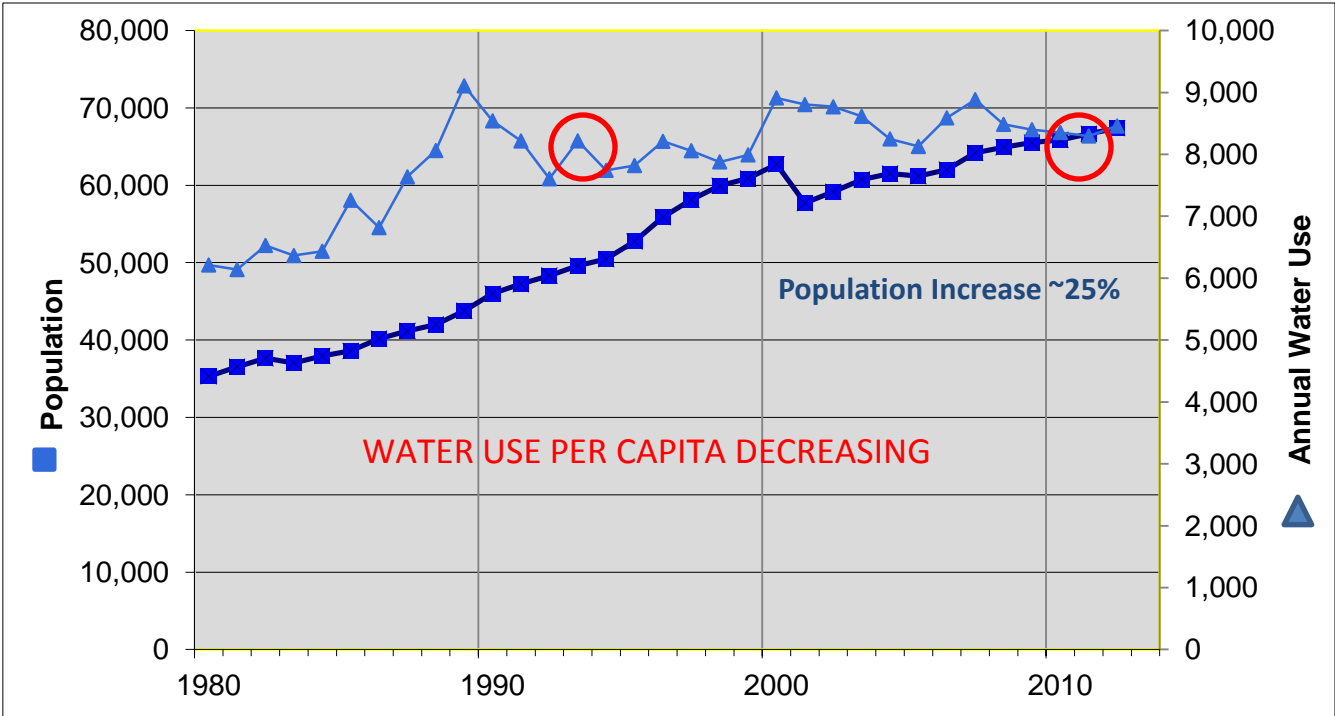
- Prior Appropriation doctrine
 - first in time, first in right
- Little Colorado River Adjudication
 - state court to determine scope, extent & priority of federal reserved water claims (includes all City water supplies)
- Gila River Adjudication
 - applies only to Woody Mountain well field
- Northeastern Arizona Indian Water Rights Settlement (Navajo-Hopi)
 - on-going since mid 1990s...Summer 2012 Tribal Council's voted down most recent Settlement Agreement



Inner Basin Spring

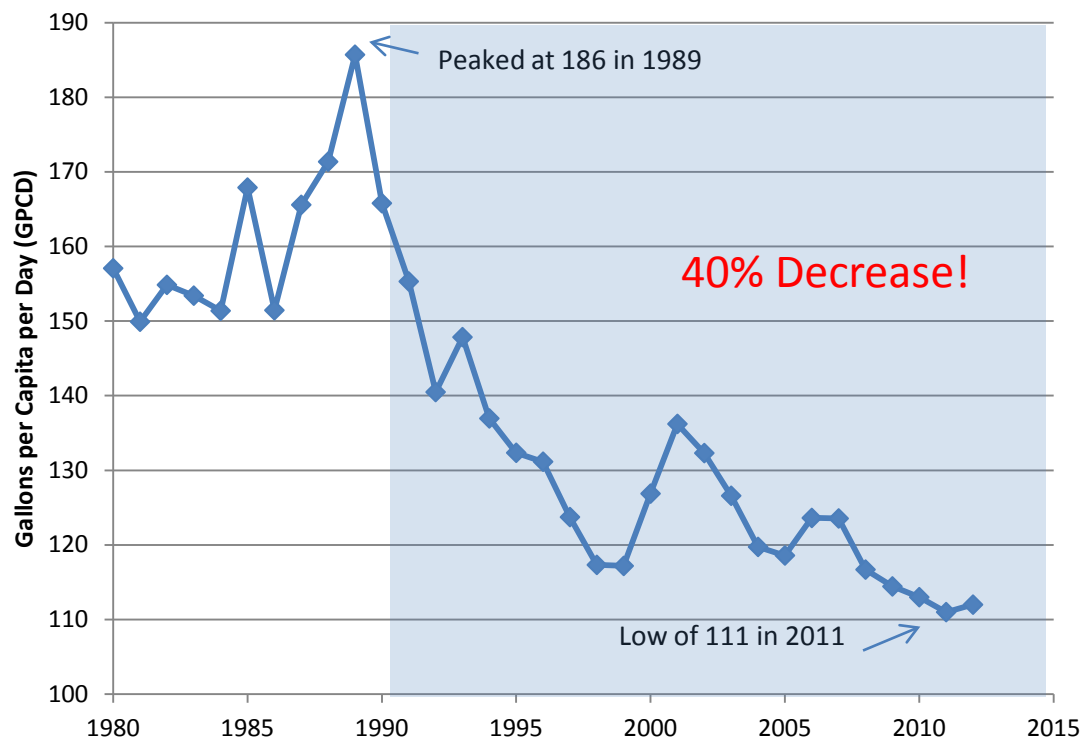
Water Use and Water Supplies: Data Trends Useful For Planning

City of Flagstaff Population and Water Use



Population Source:
 Arizona Department of Economic Security
 Research Administration - Population Statistics Unit
 Note: Estimate Series 2001 thru 2004 reflects revised estimates as of 2/27/06.

Historical & Current Use



1990: Council Adopted

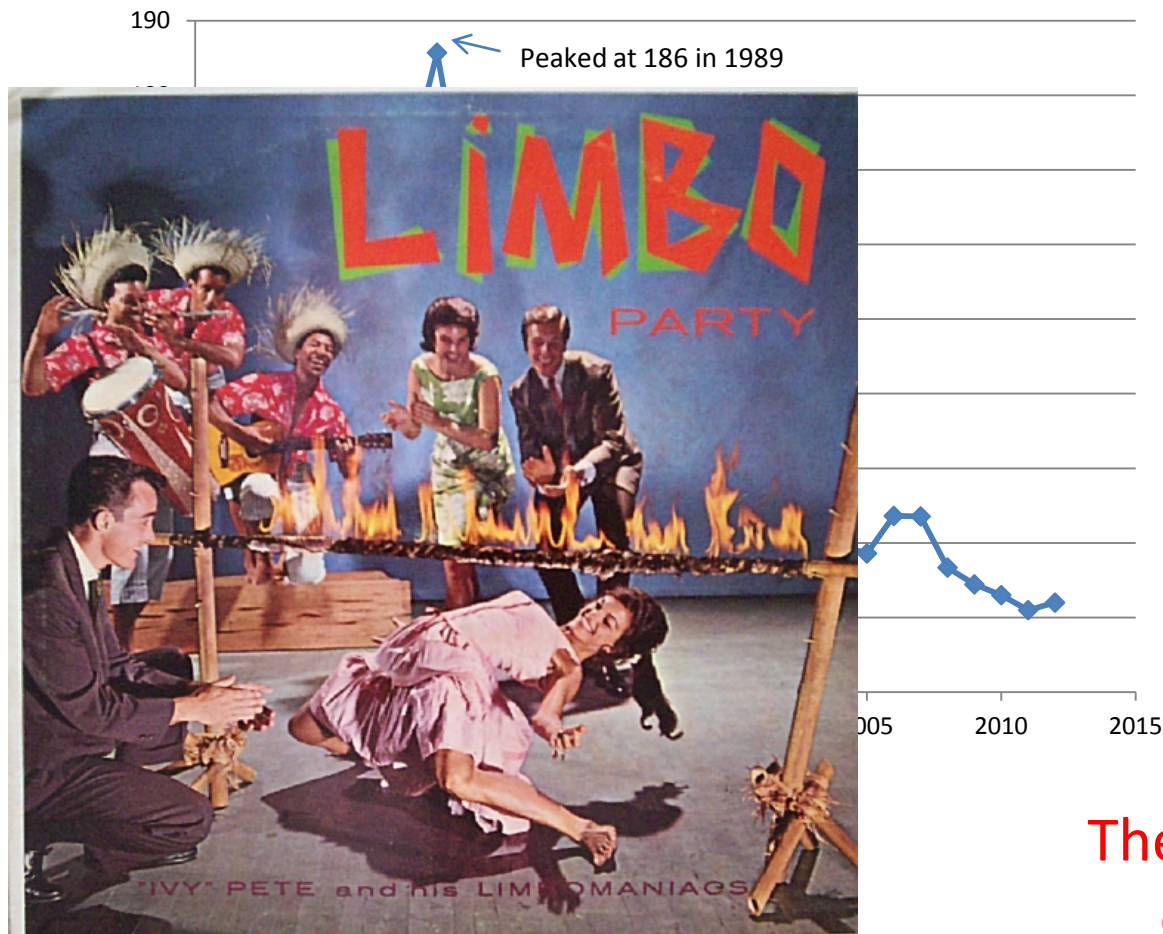
Conservation Ordinance

- Inverted Rate Structure
- Odd/Even Watering days
- Rebate Program - Toilets, Turf, Washing Machines, Hot Water RE-circulators

Since 1991, ~4,800 toilets have been converted

A total of ~ \$390,000 spent on the rebate program to date

Historical & Current Use



- 1990: Council Adopted Conservation Ordinance
- Inverted Rate Structure
 - Odd/Even Watering days
 - Rebate Program - Toilets, Turf, Washing Machines, Hot Water RE-circulators

The real question: How low can we go?

M.D. SHELTON



1990: Council Adopted Conservation Ordinance

- Inverted Rate Structure
- Odd/Even Watering days

Rebate Program

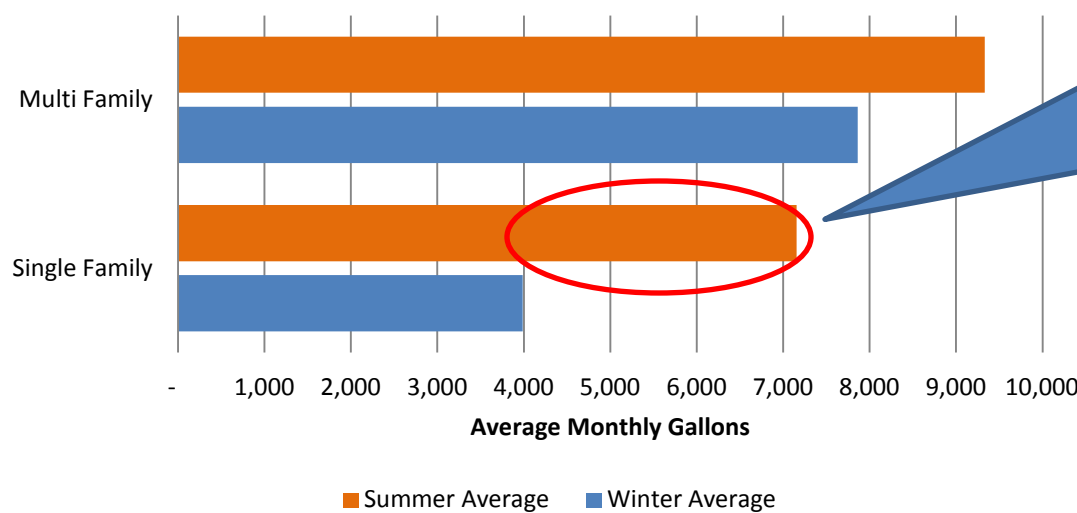
- Toilets
- Turf
- Washing Machines

Enforcement

- Water cops

In the last 10 years, about 800 warnings have been issued. 48 were fined.

Residential Average-Monthly Summer & Winter Water Use Per Household 2012

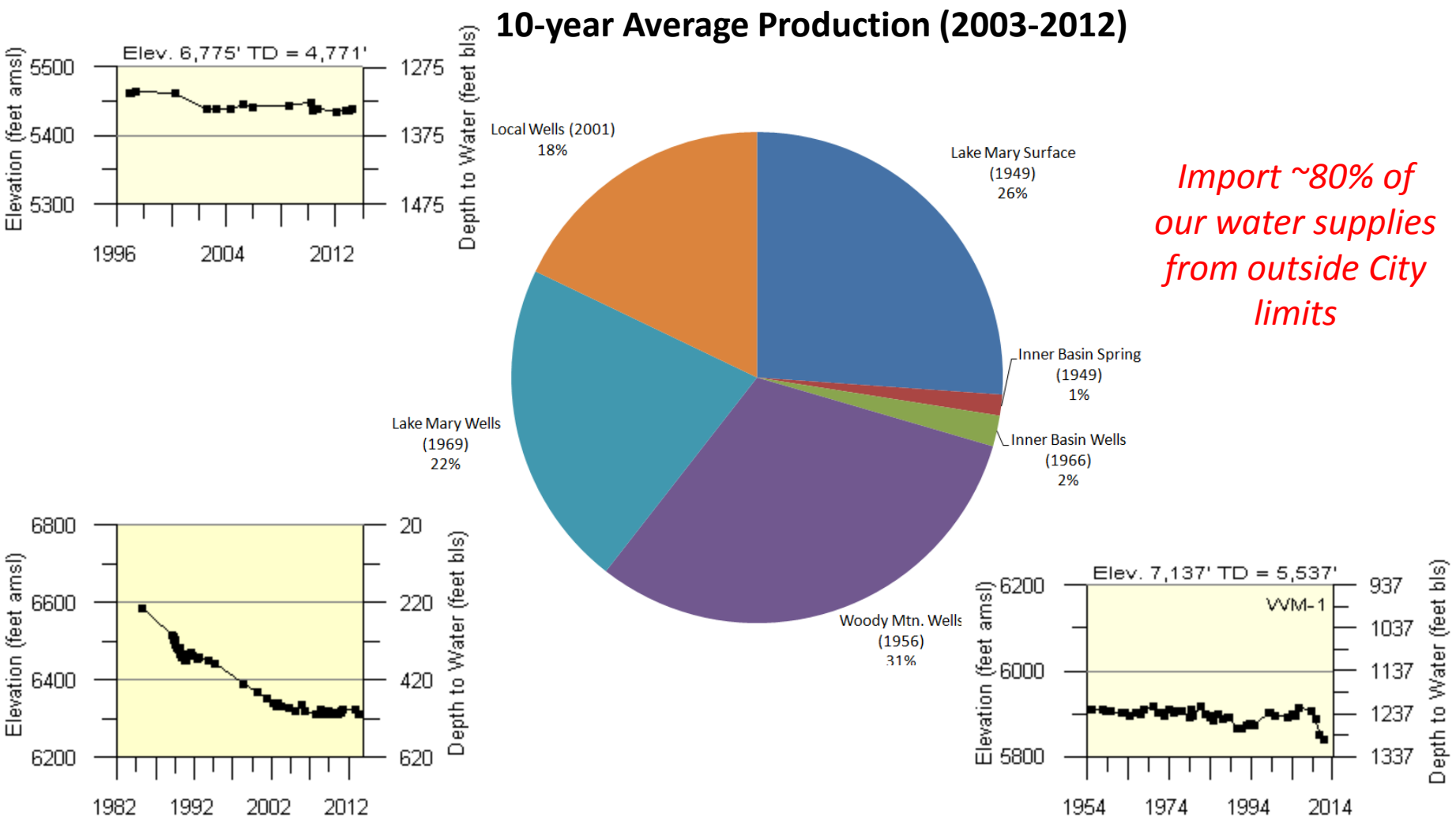


Can we do better?

- Lawn conversion
- Watering efficiency (sprinklers, time of day)
- Eating out of your neighbors garden

*Data is from customer service annual billed consumption for CY 2012

Historical & Current Use

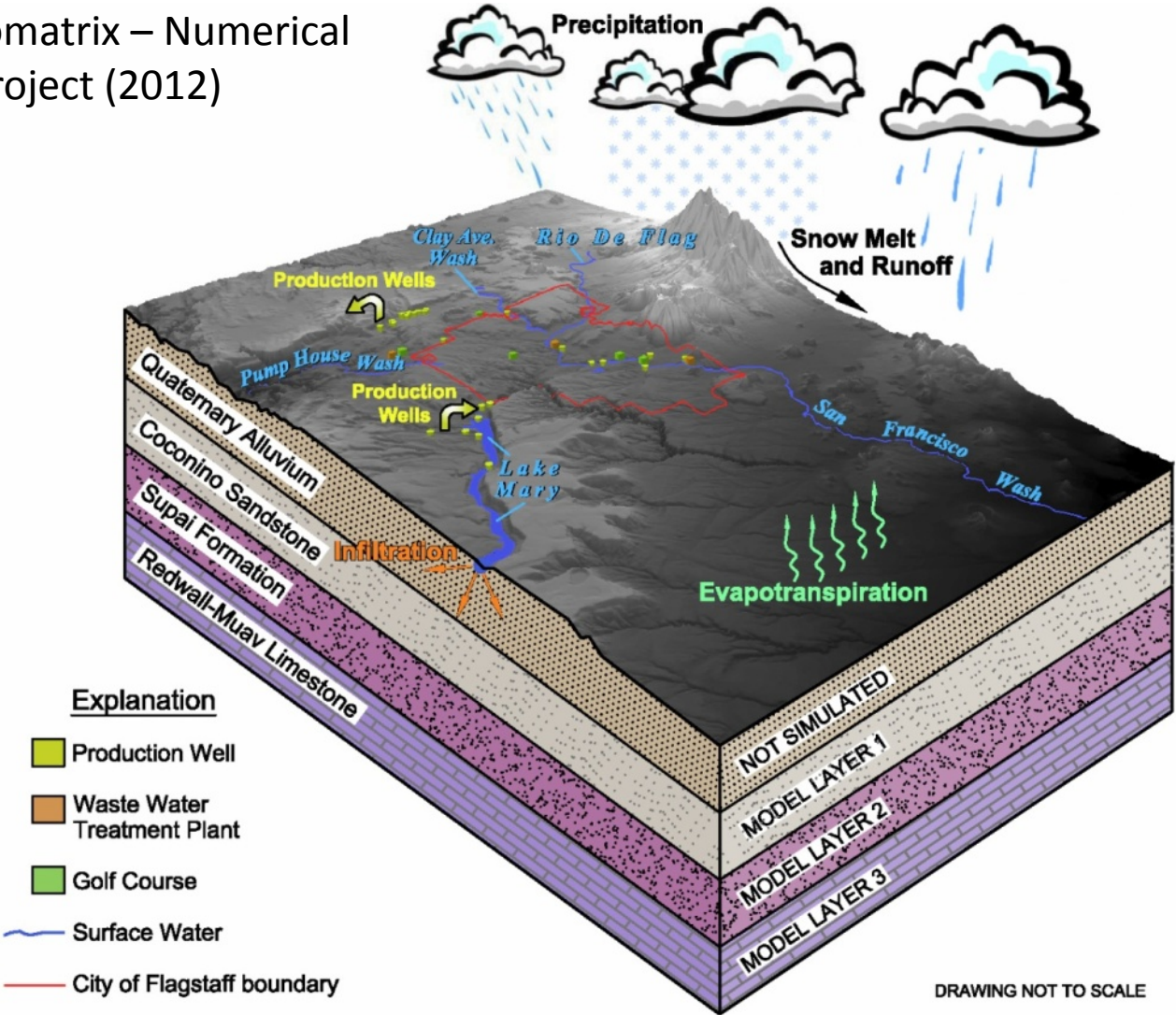


Physical Availability of Supplies

City contracted with AMEC Geomatrix – Numerical Groundwater Flow Modeling Project (2012)

USGS Northern Arizona Regional Groundwater Flow Model (NARGFM)

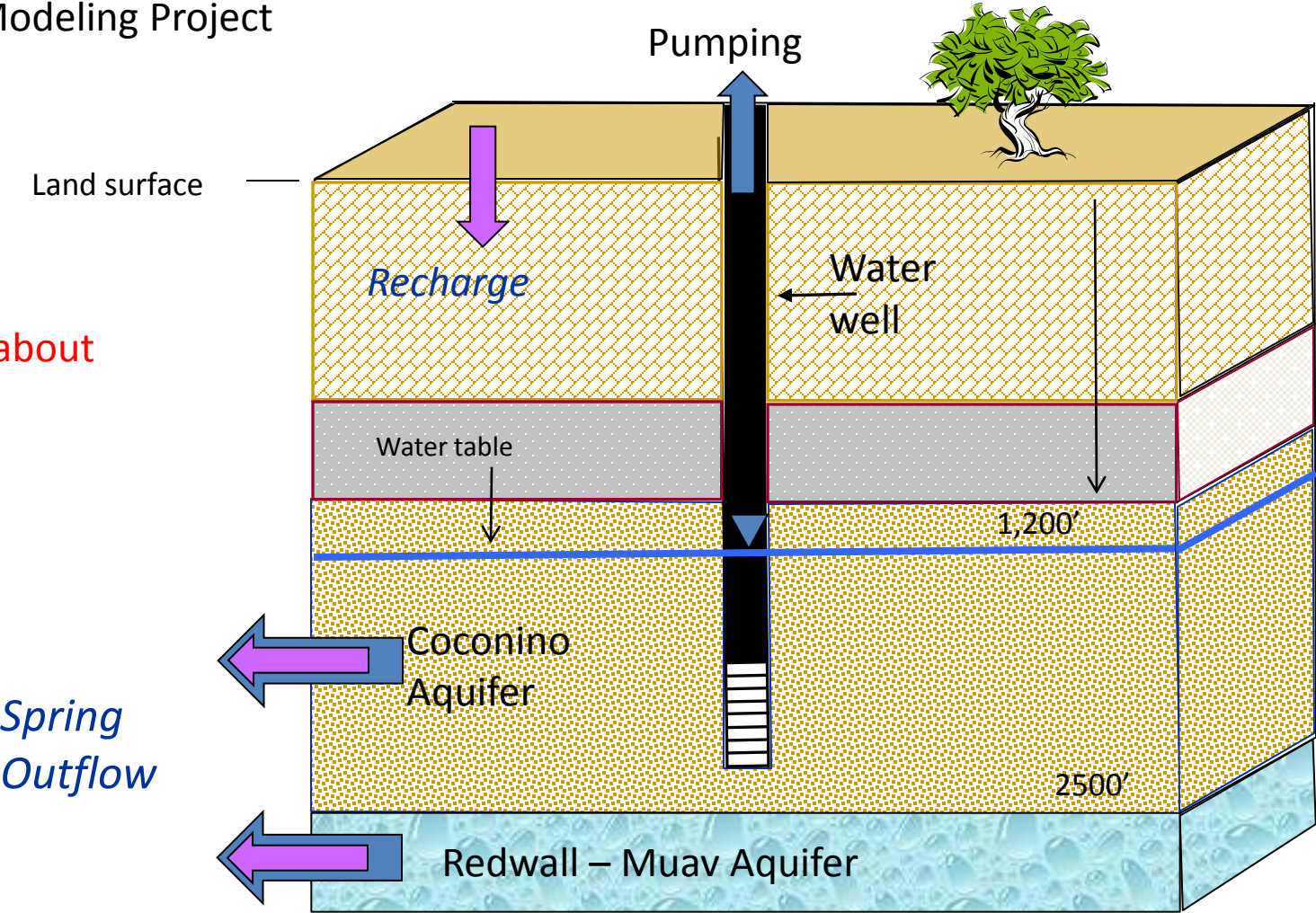
A tool for learning about a system



Physical Availability of Supplies

City contracted with AMEC Geomatrix – Numerical Groundwater Flow Modeling Project

A tool for learning about a system

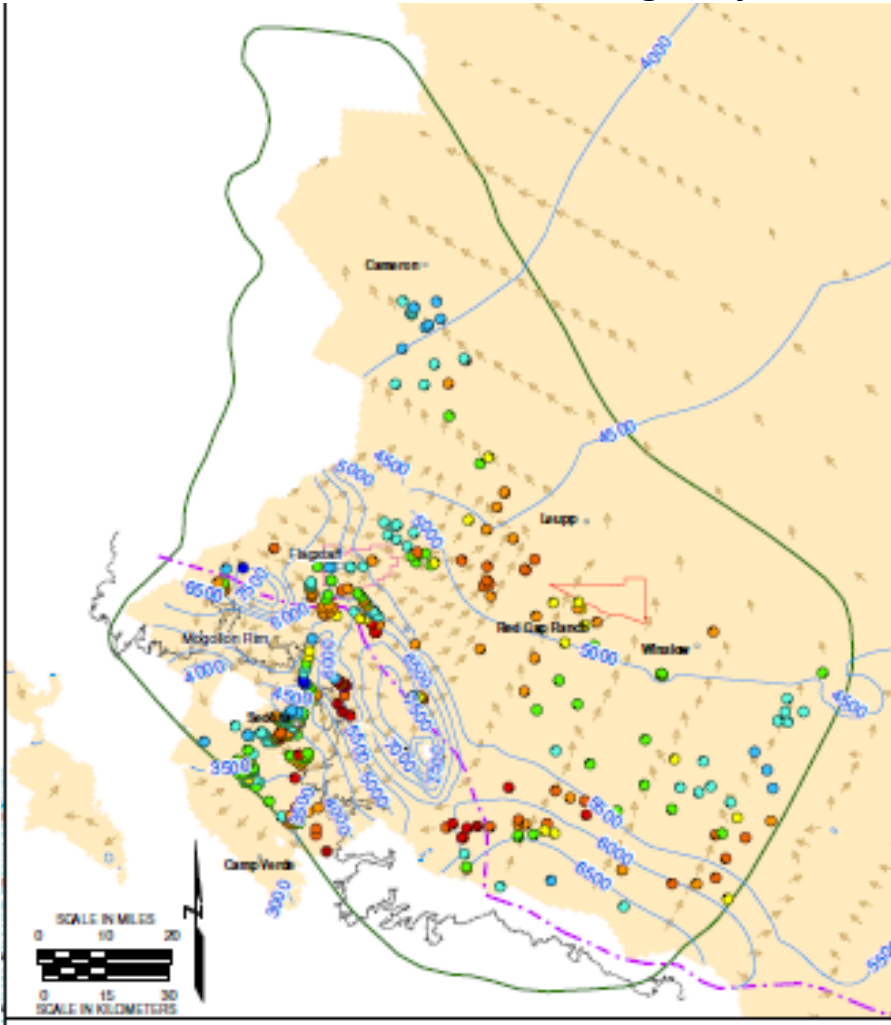


City contracted with AMEC Geomatrix – Numerical Groundwater Flow Modeling Project

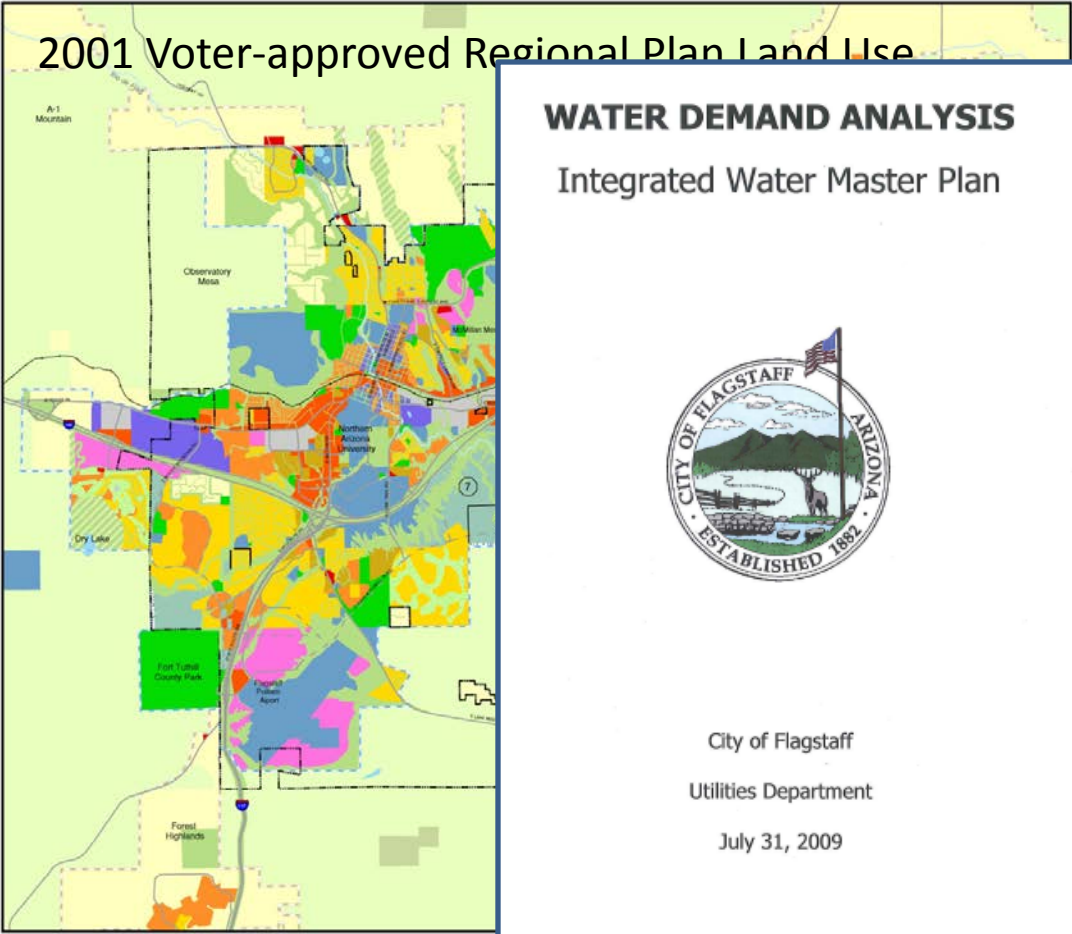
Model calibrated to 2010 data

Provides a starting point to run simulations to address the question of long-term environmental impacts

- 1. Flagstaff and Navajo Nation assessing possible impacts to Clear Creek, Chevelon Creek, and Little Colorado River from groundwater pumping at Red Gap Ranch and Leupp Wellfields



What is our FUTURE?



WATER DEMAND ANALYSIS

Integrated Water Master Plan

City of Flagstaff
Utilities Department
July 31, 2009

Flagstaff Area
REGIONAL LAND USE AND
TRANSPORTATION PLAN

Map 4: City Land Use Plan

Land Uses

- Rural Agriculture (<1 du/ac)
- Very Low Density Residential (<1 du/ac)
- Low Density Residential (1-5 du/ac)
- Medium Density Residential (6-12 du/ac)
- High Density Residential (>12 du/ac)
- Mixed Use
- Commercial Neighborhood
- Commercial Regional/Community
- Office/Business Park - Light Industrial
- Industrial Light/Medium
- Industrial Heavy
- Institutional
- Parks
- Urban Open Space
- Rural Open Space
- Golf Course
- Planning Reserve Area
- Public Multiple Use
- Transition Zone

City Billing Data

Primary Eight Year Water Consumption Averages	
Single Family Housing Units	212 GPHD
Family Attached Housing Units	173 GPHD
Apartment Complexes	160 GPHD
Industrial/Institutional Uses	5251 GPAD
Commercial Uses	861 GPAD
Hotel Room Use	106 GPD
Modular Neighborhood	164 GPHD

1) 2001 Voter-approved Regional Plan Land Use and GIS

- Assumed Maximum Density & Max Zoning

Population = ~180,000

2) Apply City Billing Data Per Category

Water Demand=12,000 AF/year

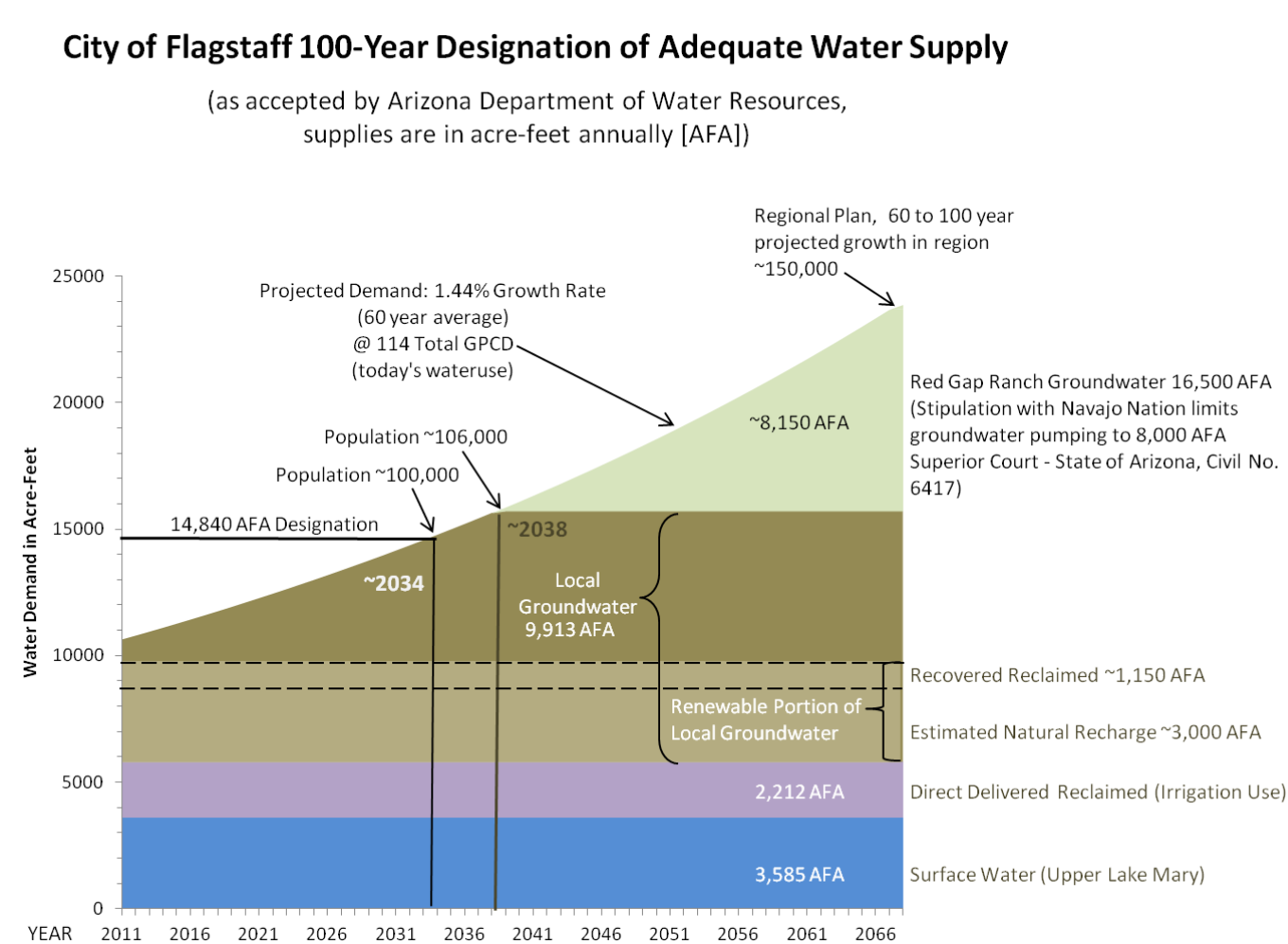
Summary Eight Year Water Consumption Averages

Single Family Housing Units	212 GPHD
Multi Family Attached Housing Units	173 GPHD
Apartment Complexes	160 GPHD
Industrial/Institutional Uses	5251 GPAD
Commercial Uses	861 GPAD
Hotel Room Use	106 GPD
Modular Neighborhood	164 GPHD



Water Demand Scenarios

WHEN may we need more supply and HOW can we meet this demand of 12,000AF/yr?



Water Demand Scenarios

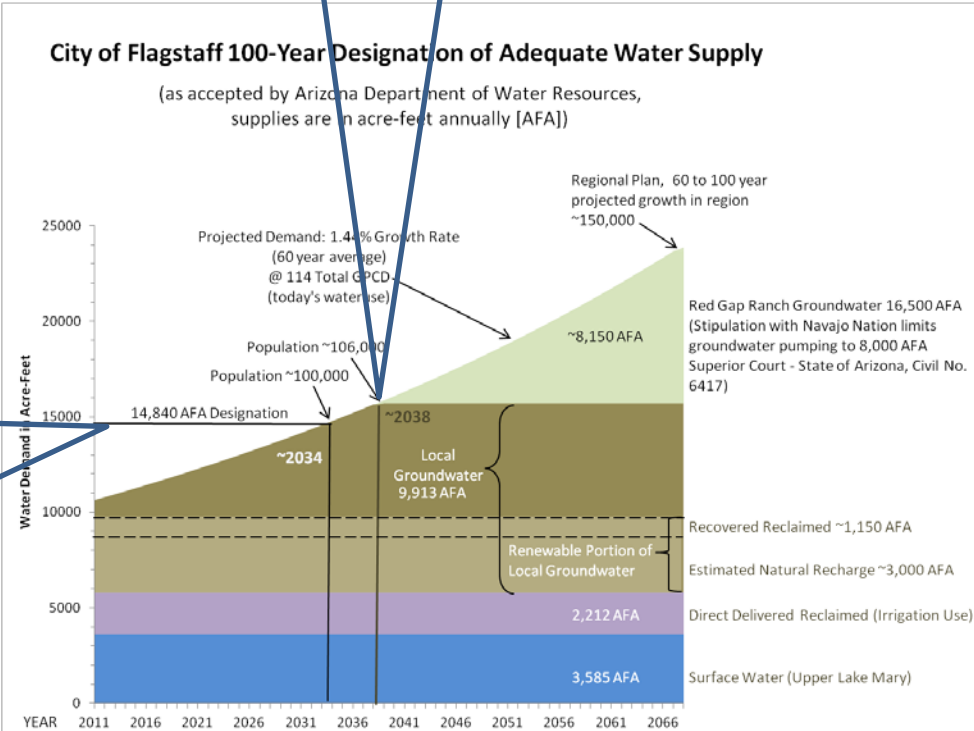
This is just one scenario

ADWR Hydrologists have approved that the City of Flagstaff has the physical, legal, financial capability to meet our 100-year water needs over the next 20 years

20-year demand determination:

- Current Demand ~8,300 AF/yr
- Committed Demand ~700 AF
- Projected New Demand ~ 3,500 AF

~25 years, Flagstaff needs an additional water supply



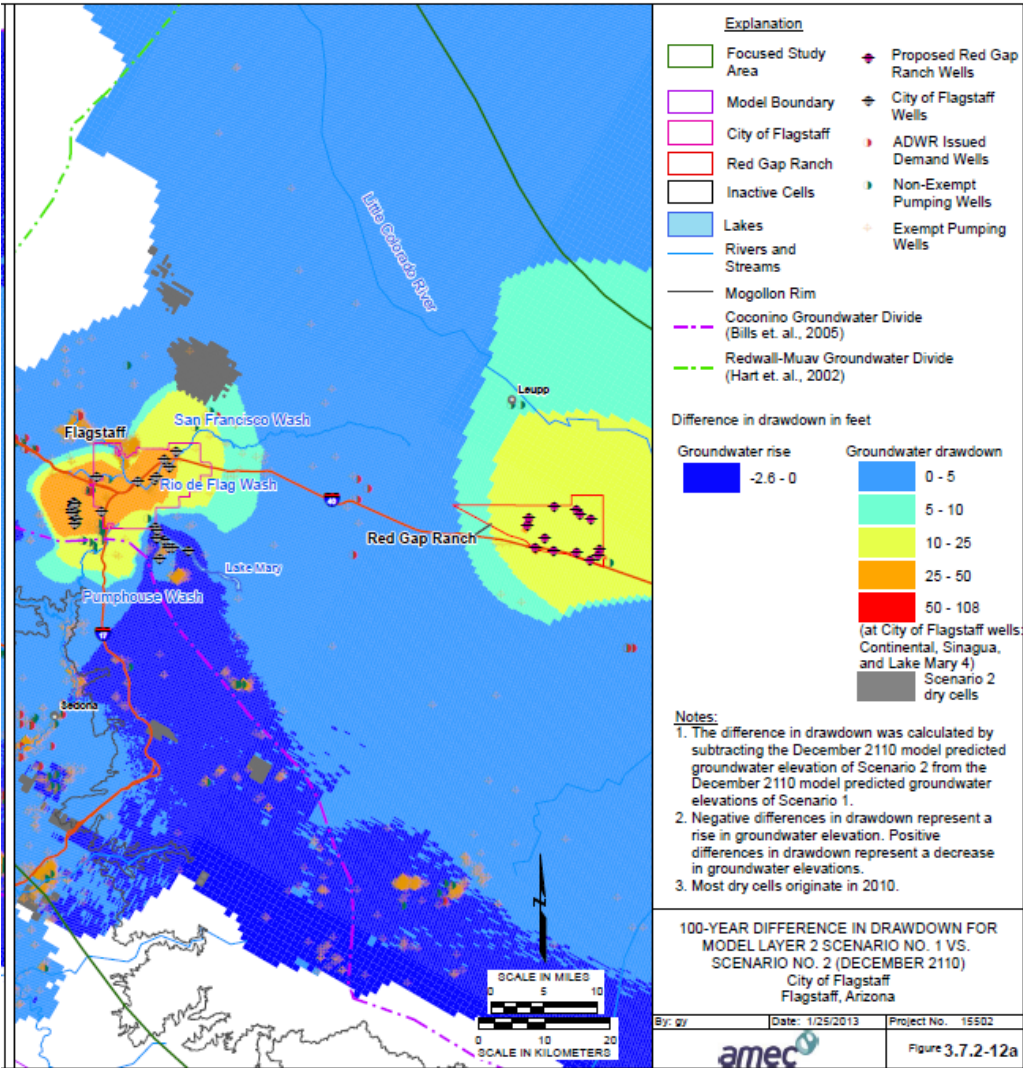
Water Demand Scenarios

USGS Northern Arizona Regional Groundwater Flow Model (NARGFM)

100-years of pumping

- 9,913 AF/yr groundwater wells
- 8,000 AF/yr Red Gap Ranch

Max drawdown after 100 years = 108 feet in 2 local wells and 1 Lake Mary well; about 25 feet at Red Gap Ranch. *This is about 10% of the C-aquifer thickness.*



Physical Water Supply Options: (12,000 AF/year)

- Conservation
- Reclaimed Water Reuse
- Wells
- Importation

Volume of water (AF) generated for each option

Cost of water (AF) for each option

- Capital costs
- O & M costs
- Electrical costs
- 10-year payback
- Cost savings to customer & City (Conservation)

Potential Water Conservation Benefit of Mandatory Rainwater Harvesting for New Development

How much water can be saved by implementing Rainwater Harvesting?

Connor Boyle and Richard Immelt, COF Stormwater Management Section

Purpose

The Flagstaff City Council has asked a group of citizen stakeholders to develop a Rainwater Harvesting (RWH) Ordinance as a means of water conservation. This Group has many issues to consider, not the least of which is: what are the potential benefits of RWH to the City's overall water supply situation? This report attempts to quantify the actual amount of water that could be captured by implementing a RWH Ordinance.

Procedure

To determine the potential quantity of rainwater that could be harvested, the total area of existing rooftops (the catchment area) was determined and then used to predict the total roof area if all currently undeveloped land were developed. An existing GIS layer that contains building footprints was used in conjunction with a current land use layer to determine the total existing building footprint area for each land use type. It was assumed that the building footprint is a close approximation of the roof area in most cases. The ratio of building footprint area to total land use area was calculated and used to estimate the future rooftop area for the corresponding undeveloped land use. The undeveloped land use areas were based on the 2001 Regional Plan. The land use categories for Open Space, Land Bank, and Right-of-Way were not used for this exercise as they do not generally contain structures. The Institutional land use categories for Churches, colleges, Elementary School, Museum, University, and High School were also not used because there were no corresponding categories in the Regional Plan. The GIS layers are shown in the attached Figures.

Conservation – High Efficiency Toilets

New Buildings

- ❖ HET 1.3 gallon/flush composting toilet (1 per house)
- ❖ Clivus Multrum toilet - \$6,135 and 6 ounces / flush
- ❖ Saves 1.25 gallon/flush or 5,019 gallons / year
- ❖ Regional Plan - # of new single family homes (17,100)

1860s

“earth closet”



2000s

“BioLet” - \$1,250.00



Potential Water Savings

263 AF/year
(\$1,352/AF over 10 years)

Conservation – Turf Removal

Comparison of Water Conservation Alternatives

March 29, 2011

Turf Removal - Existing Homes

	Start-up		Start-up & Ongoing	
Capital Costs	1 st Year		10-Years	
Turf Removal & Xeriscape Planting for 1500 sq. feet ¹	\$2,800.00		\$2,800.00 \$0.00	
Utility Rebate to Customer	\$500.00	year start-up		
Average COST per Residential Site	\$2,300.00		\$2,800.00	
Volume of Water Saved ^{2,8}	0.09	AF/year	0.88	AF
Savings to the Customer				
Water Savings ³	\$221.66	1 st year	\$2,541.06	
Estimated Payback Time ⁴	10	years		
Savings to the City Utility				
Reduced Electrical Costs ⁵	\$14.96	1 st year	\$238.42	
Energy Savings ⁶	113	KWh	1,131	KWh
Estimated Cost per Acre-Foot ⁷	<div> <div>\$297</div> <div>AF</div> </div> <div> <div>\$0.91</div> <div>1000 gallons</div> </div>			
Estimated Maximum Savings				
Potential Customers ⁸	17,035		1,499	AF/year

ASSUMPTIONS

1 - Agassiz Landscaping charges \$1.39/sq. ft. to replace landscaping with landscape fabric and decorative rock. Additional low water plant costs vary but are required to be planted in order to get a rebate. Plants may cost about \$600 total per a quote from Agassiz Landscaping (4/28/10). The minimum amount of turf removed must be 1500 square feet in order to receive a rebate of \$500. Customers could do this work themselves but for analysis purposes, a contractor bid was selected.

- The "Upper Verde Watershed Regional Water Conservation Program Final Report"(Larson, 2008) stated on page 41 that turf removal would save a household 28,675 gallons/year. However, the growing season in Flagstaff is shorter and this calculation is most likely conservative and was based on irrigating for 6 months - April through October.
- The "Long-Term Financial Plan and Rate and Fee Study" (Willdan, 2010) indicates that the average home is in Tier 2 of the billing range. Therefore, for this calculation we assumed the home is in Tier 2 of the billing range with a savings of 28,675 gallons/year for water and sewer. We divide the 28,675 gallons in half and use those amounts to calculate the water fee for each Tier since the irrigation water doesn't comprise all water use for each Tier. 28,675 gallons broken into two Tiers: Tier 1(\$3.52 per 1,000 gallons x 14.337(half of 28,675 gallons/1,000 gallons)) + Tier 2(\$4.34 per 1,000 gallons x 14.338(half of 28,675 gallons/1,000 gallons)) + sewer cost at \$3.80/1000 gallons x 28.675(28,675 gallons/1,000 gallons) = \$221.66 saved in 1 year. Tier 1 goes to 3,700 gallons. Tier 2 goes from 3,701 to 6,400 gallons. This amount uses 2015 costs for water and sewer.
- Average cost per residential site of \$2,300 divided by water & sewer savings of \$221.66 = 10 years estimated payback time.
- Using costs associated groundwater and the SHOP Well, our most expensive water, and a 3% rate increase per year for the 5 years after existing rate increase supply. September 2010 electrical charges were \$0.13 KWh or \$170/AF. Therefore, 0.09 AF/year water saved x \$170/AF = \$14.96 electrical cost savings first year or \$238.42 over 10 years assuming a 10% per year increase in total cost of electricity.
- Energy savings calculated using the SHOP Well, September 2010 figures for electrical use per acre-foot of water produced [1,285 KWh / AF].
- Rebate per residential site minus 10-year reduced electrical costs to utility divided by 10-year volume of water saved.
- Removal of high water using landscaping and converting the landscape to xeriscape plants was estimated to save each customer 28,675 gallons per year. There are potentially 17,035 single family homes that could convert their landscaping as 64 have already done so and received rebates(17,100 single family homes - 64 that have received rebates = 17,035 homes that potentially could receive rebates). Assuming that the conversion costs \$2,000 and the rebate is \$500, it would take 8 years to recover the costs. Water savings would by all these customers could potentially be over 1,499 acre/feet.

Increased treatment @ Rio WRF to remove
Pharmaceuticals & Endocrine Disrupting Compounds
then recharge via Rio de Flag



Estimated New
Groundwater Augmentation *DRAFT*

4,480 AF/year

\$974/AF pilot test over a 10 year period)



Local Supplies

Wells



Estimated New Water Well
716 AF/year (493 GPM)
(\$830/AF over 10-year period)

Imported Supplies

North Central Arizona (aka Western Navajo Pipeline) And Colorado River supply

- ❖ Northeastern Arizona Indian Water Rights Settlement
- ❖ non-Indians may elect to participate to upsize and extend south from Cameron



❖ USBR Coconino Plateau Feasibility Study



CAP
CENTRAL ARIZONA PROJECT

New Surface Water Supply *DRAFT*

8,000 AF/year
(???) / AF)



TABLE 6
Future Water Supply Options
Preliminary Estimates of the Volume of Water and their Cost
(over a 10-Year Period) DRAFT

	Volume of Water Saved (AF/yr)	Cost of Water (AF)	Upfront Cost to Customer
1. Existing Cost of Water (1st half FY11)			
Groundwater		\$980	
Lake Mary WTP Surface Water		\$320	
		Cost of Water over 10 year period	
2. Water Conservation – Active Rainwater Harvesting			
new Residential (cisterns)	285	\$5,500	\$3,600
new Residential (rain barrels)	50	\$1,705	\$100
new Commercial (cisterns)	30	\$2,650	\$4,720
new Institutional (cisterns)	20	\$2,545	\$4,940
existing <u>buildings</u> (cisterns)	610	???	???
	995 AF/year		

Future Water Supply Options

Preliminary Estimates of the Volume of Water and their Cost (over a 10-Year Period)

DRAFT

	Volume of Water Saved (AF/yr)	Cost of Water (AF) for 10 years	Upfront Cost to Customer
3. Water Conservation - Other			
Hot Water Re-circulating pump	190	\$1,360	\$130
Composting Toilets	260	\$1,350	\$5,890
Incinerating Toilets	340	\$1,290	\$1,860
High Efficiency Clothes Washer	190	\$500	\$995
Turf (grass) removal	1,500	\$300	\$2,300
High Efficiency Toilets (1.3 gal)	70	\$25	\$170
<i>retrofits 1980 to 1994</i>			
<i>2,550 AF/year</i>			

Future Water Supply Options

Preliminary Estimates of the Volume of Water and their Cost

(over a 10-Year Period)

DRAFT

4. Imported and Other water supplies	Volume of Water Saved (AF/yr)	Cost of Water (AF) for 10 years	Upfront Cost to Customer
Indirect Reclaimed Water Reuse*	4,480	\$975	
New Groundwater well	715	\$830	
Red Gap Ranch	12,000	\$3,857	
North Central Arizona	12,000	\$???	
Colorado River supply	12,000	\$3,000	

- Advanced Wastewater Treatment - HiPox Technology assumes \$4 million capital cost

➤ Summary

- The Utilities Division is proactive in planning to meet existing and future water needs
- A variety of options have been identified to meet future needs
- Staff have conducted detailed cost analyses of those options
- Planning scenarios for the future have incorporated possible changes in climate, growth rates and water use



Solar Panels at Wildcat Hill WWTP, 2012

➤ Our Water Future

- Given land uses identified in the voter-approved Regional Plan, conservation is a component, but not a total solution, in meeting those needs at build-out

➤ Next Steps

- Continue to update & finalize the Water Resources Master Plan
- The Plan is available on the City's website (Utilities)

Thank you!

eyoung@flagstaffaz.gov
(928) 213-2405



Infrastructure Financing:

- Up front cost
 - Developer Pays for Infrastructure & Supply
 - Public-Private Partnerships (P³)
 - BOR Rural Water Supply Act
 - State Water Resources Development Fund
 - Bonds
- How we repay
 - Water rates
 - Sales tax
 - Capacity Fees
 - Others?

Infrastructure Financing:

- Up front cost
 - Developer Pays for Infrastructure & Supply

Current Policy by Utilities states developers >700 homes pay for water supply and infrastructure

Proposed in front of Council in Water Policy document, recommending triggers related to peak demand that require developers pay for water supply and infrastructure

